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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

I.L.C. HATTEN-HECKMAN

DEN HAAG, DEN
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LA HAYE, LE
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Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

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Display device with channels with gradually decreasing depth at peripheral part

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Remarques:

Display device with channels with gradually decreasing depth at peripheral part.

The invention relates to a display device having a plate provided with longitudinal channels and a peripheral part adjacent to at least one side of the channels in which channels electrodes are provided which electrodes exit the channels onto the peripheral part.

The invention also relates to a method for manufacturing a display device having a plate provided with longitudinal channels and a peripheral part adjacent to at least one side of the channels in which channels electrodes are provided which electrodes extends in the channels and exit the channels onto the peripheral part.

Such devices are for instance PDP (Plasma Display Panels) and PALC (Plasma activated Liquid crystal) devices.

In PDP and PALC devices the channels comprise gases. These gases can locally be made into plasma by generation of electrical fields inside the channels. Electrical fields are generated by applying voltages to electrodes in the channels. The generated plasma can be used to switch LCD elements (as in PALC devices) or to excite phosphors (such as in PDP's).

The channels are made in a plate. The plate has a peripheral part adjacent to at least one side of the channels. The electrodes exit the channels and extend over the peripheral part. At the peripheral part connections between the electrodes and driving means (or connections to driving means) are made.

There exist an ever more urgent need for high-quality, highly-reliable devices of the type described in the opening paragraph. The price of such devices is greatly dependent on the percentage of devices with an acceptable quality and reliability.

It is an object of the invention to increase the quality and the reliability of a device as described in the opening paragraph.

To this end a device in accordance with the invention is characterised in that the peripheral part extends in a plane in between a bottom plane through the bottom of the channels and a top plane through the top of the channels, and each channel comprises a sloping ramp sloping from the bottom plane to the plane and ending in the peripheral part.

The quality and reliability of the device is highly dependent on the electrical fields generated inside the channels. The fields inside the channels are generated by electrical voltage differences between electrodes inside the channels. The driving means generate voltages but the actual voltages inside the channels are, as the inventors have realised, to a great degree dependent on the connections between the driving means and the electrodes inside the channels. In particular the transition region between the channels and the peripheral part (i.e. where the electrodes exits the channels and extends unto the peripheral part) has been found by the inventors to have a mayor influence. By having the peripheral region extending in a plane in between a plane through the bottom of the channels and a second through the top of the channels, and each channel comprising a sloping ramp extending from the plane of the bottom of the channels to the plane of the peripheral part and ending in the peripheral part steps in height between the channels and the peripheral part are prevented. The inventors have realised that occurrence of such steps are frequently a cause of problems.

The method in accordance with the invention is characterised in that prior to providing the channels the peripheral parts are provided in the plate at a depth in between the bottom and the top of the channels to be provided, whereafter the channels are provided by means of moving the grinding wheel(s) over the plate along a direction, the grinding action being started at a position at some distance from an outer edge of the plate and being stopped before the grinding wheel reaches the opposite outer edge of the plate.

In this manner the channels are provided at each end with a sloping ramps which smoothly runs over in the peripheral part. The sloping ramps follow the contour of the grinding wheel.

Preferably the electrodes are provided at the bottom of the channels and each channel comprises a central part with a first depth, flanked at at least one or preferably both sides by a second portion with a reduced depth, a third portion with a depth corresponding to

the first portion, the bottoms of the first, second and third portion being extending in the second plane, and a fourth portion comprising the sloping ramp, the second portion forming a groove in the plate in which groove a sealing material is provided.

The second portions of the channels, having a reduced depth (in respect of the flanking first and second portions) form a groove. In said groove a sealing material (for instance glass frit) is provided. The channels are thereby sealed off from the outside environment. The electrodes in the channels are provided at the bottom of the channels. The risk of discontinuities in the electrodes is small.

These and other aspects of the invention are apparent from and will be elucidated with reference to the embodiments described hereinafter. Similar components in the Figures have identical reference numerals.

In the drawings:

Figure 1 is a schematic block diagram of a conventional flat panel display system;

Figure 2 is a perspective view of a part of a conventional PALC display device.

Figure 3 is a view of a part of a display device in accordance with the invention.

Figure 4 is a cross-sectional view through the part shown in Figure 3.

Figure 5 is another cross-sectional view through the part shown in Figure 3.

Figure 6 illustrates the method in accordance with the invention.

The figures are not drawn to scale and corresponding numerals in the figures refer to the same or similar oparts of a device.

Figure 1 shows a flat panel display system 10, which represents a typical PALC display device and the operating electronic circuitry. With reference to Figure 1, the flat panel display system comprises a display panel 12 having a display surface 14 that contains a pattern formed by a rectangular planar array of nominally identical data storage or display elements 16 mutually spaced apart by pre-determined distances in the vertical and horizontal directions. Each display element 16 in the array represents the overlapping portions of thin narrow electrodes 18 arranged in vertical columns and elongate, narrow channels 20 arranged in horizontal rows (the electrodes 18 are hereinafter referred to from time to time as 'column electrodes', the channels 20 performing the function of 'row electrodes'). The display elements 16 in each of the rows of channels 20 represents one line of data.

The widths of column electrodes 18 and channels 20 determine the dimensions of display elements 16, which are typically of rectangular shape. Column electrodes 18 are deposited on a major surface of a first electrically non-conductive, optically transparent substrate 34, and the channel rows are made into a second transparent substrate 36 (Figure 2). Skilled persons will appreciate that certain systems, such as reflective display of either the direct view or projection type, would require that only one substrate be optically transparent. Column electrodes 18 receive data drive signals developed on parallel output electrodes 22' by different ones of output amplifiers 23 (Figure 2) of a data driver circuit 24, and channels 20 receive data strobe signals of the voltage pulse type developed on parallel output conductors 26' by different ones of output amplifiers 21 (Figure 2) of a data strobe or strobe means or strobe circuit 28. Each of the channels 20 includes a reference electrode 30 (Figure 2) to which a first voltage, such as ground, common to each channel and data strobe 28 is applied.

To generate an image on the area of display surface 14, display system 10 employs a scan control circuit 32 that co-ordinates the functions of data driver 24 and data strobe 28 so that al column of display elements 16 of display panel 12 are addressed row by row in row scan fashion. Display panel 12 may employ electro-optic materials of different types. For example if is uses such material that changes the polarisation of incident light rays, display panel 12 is positioned between a pair of light polarising filters, which co-operate with display panel 12 to change the luminance of light propagating through them. The use of a scattering liquid crystal cell as an electro-optical element would not require the use of polarising filters, however. As LC materials are presently the most common example, the description will refer to LC materials but it will be understood that the invention is not limited thereto.. A colour filter (not shown) may be positioned within display panel 12 to develop multi-colored images of controllable colour intensity. For a projection display, colour can also be achieved by using three separate monochrome panels 12, each of which controls one primary colour.

Figure 2 illustrates a PALC display panel using LC material. Only three of the column electrodes 18 are shown. The row electrodes 20 are formed by a plurality of parallel elongated sealed channels underlying (in Figure 2) a layer 42 of the LC material. Each of the channels 20 is filled with an ionizable gas 44, closed off with a dielectric sheet 45 typically of glass, and contains on an interior channel first and second spaced elongated electrodes 30, 31 which extend in this example the full length of each channel. The first electrode 30 is at a first potential (for instance grounded) and commonly called the cathode. The second electrode 31 is called the anode, because it will supply and be supplied with a, relative to the potential on the

cathode, positive pulse voltage (strobe pulse) sufficient to cause electrons to be emitted from the cathode 30 to ionise the gas in the channel(s). Each channel has, in turn, its gas ionised with a strobe pulse to form a plasma and a grounded line connection to a row of pixels in the LC layer above. When the strobe pulse has terminated, and after de-ionisation has occurred, the next channel is ignited and turned on. Since the column electrodes 18 each cross a whole column of pixels, only one plasma row connection at a time is allowed on to avoid cross-talk. The height of the strobe pulse voltage inside the channel will determine whether or not the plasma row is turned on. The height of the strobe pulse inside the channels is not just dependent on the voltages supplied by the output amplifiers 12, since losses or changes may occur between the output amplifiers and the electrodes within the channels. The most clear example of such a loss would be a discontinuity in an electrode (or the lead to the electrode) which would lead to a malfunction. An accurate transmission and a reduction of possible losses of the strobe pulse between the supply means (in this example including the amplifiers 21) and the electrodes inside the channels is therefore an important factor for the reliability and quality of the display device. The inventors have realised that steps in height in the channels form a risk in this respect.

Figure 3 shows a plate 36 provided with channels. The channels comprise a central first portion 52 flanked at both side in this example by a second portion 53, a third portion 54 and a final portion 55. The final portions 55 are indicated by dotted lines and extend into the peripheral parts 50, 51. The final portions form sloping ramps 55.

Figure 4 shows a cross-sectional view along line. The bottom of the channels 20 filled with ionizable gas extend in a bottom plane I, the tops in a top plane II, theses planes defining the depth D of the channels 20. Each of the channels 20 in plate 36 is provided with electrodes 30 and 31. The depth D is typically, but not restricted to 0.15-0.25 mm.

Figure 5 shows the different parts of the channels. The central part 52 of the channels has a depth D, it is flanked by a part 53 which has a depth D-D' where D'<D. This can for instance be made by a groove 56. The channel depth therefor at this part 53 is relatively small for instance only 0.01 mm. The electrodes 30 and 31, however, still lie in a channel. The third portion 54 basically has a shape and form equivalent to the central portion 52, be it that the longitudinal (along the direction of the channels) dimension is relatively small. The final portion of the channels 20 is formed by a sloping ramp part 55. Immediately beside the part 54 the depth of the channels is D-D'' where D''<D and preferably D'=D''. This depth decreases towards the outer edge 57 of peripheral part 51, becoming zero on the peripheral part, which is schematically indicated in Figure 5 by line 59. The electrodes 30 and

31 lie at the bottom of the channels and extend from the channels onto the peripheral part 51. On the peripheral part 51 leads can be attached to the electrodes to apply in operation voltages to said electrodes. Because of the sloping ramp 55 the electrodes 30, 31 can be provided to smoothly, i.e. without having to overcome a step in height, extend in the channels and on the peripheral part. The groove 56 is filled with a sealing material thus sealing off the channels.

Figure 6 illustrates the method in accordance with the invention. In plate 36 a peripheral part 51 is made and a groove 56. At these parts the thickness of the plates is reduced by an amount D'. Thereafter grinding wheel 60 grinds channels to a depth of D where D>D'. The grinding moves in the directions indicated in the figures. Movement is halted before the grinding wheel reaches edge 57 of plate 36. At the other end the movement is started not at the edge of the plate but at some distance from said edge. Figure 6 is not drawn on scale, the diameter of the grinding wheel is typically 8-16 cm. Grooves 56 and peripheral parts 51 are preferably made before the provision of the channels (i.e. before the grinding action), but could be made afterwards.

It will be clear that the invention is not limited to the examples shown in the figures and described above. Although for instance the typical depth of the channels is given this is not to be considered as restrictive for the invention. The provision of a groove 56 is also, although preferred, not to be considered to be restrictive for the invention in its broadest sense. The invention is furthermore illustrated by means of a PALC device, but could also be used for other flat panel display devices such as PDP's. Each channel could comprise one instead of two electrodes.

In short the invention can be described as relating to a display device with channels with gradually decreasing depth at peripheral part. The display device (10), such as PALC or PDP, comprises a plate (36) with channels (20) in which electrodes (30, 31) are provided. The peripheral part (50, 51) extend in plane (III) in between the bottom plane (I) though the bottoms of the channels and a to plane (II) through the top of the channels. The channels comprise a sloping part (55) gradually sloping from the bottom plane (I) to the peripheral part plane (III).

CLAIMS:

1. Display device (10) having a plate (36) provided with longitudinal channels (20) and a peripheral part (51) adjacent to at least one side of the channels (20) in which channels electrodes (30, 31) are provided which electrodes exit the channels (20) onto the peripheral part (50, 51), characterised in that the peripheral part extends in a plane (III) in between a bottom plane through the bottoms of the channels (I) and a top plane (II) through the top of the channels (20), and each channel comprises a sloping ramp (55) sloping from the bottom plane (I) to the plane (III) and ending in the peripheral part.

2. Display device as claimed in claim 1, characterised in that the electrodes (30, 31) are provided at the bottom of the channels (20) and each channel comprises a central part (52) with a first depth, flanked at at least one or preferably both sides by a second portion (53) with a reduced depth, a third portion (54) with a depth corresponding to the first portion (52), the bottoms of the first, second and third portion extending in the bottom plane (I), and a fourth portion comprising the sloping ramp (55), the second portion forming (53) a groove in the plate in which a sealing material is provided.

3. Method for manufacturing a display device having a plate (36) provided with longitudinal channels (20) and a peripheral part (50, 51) adjacent to at least one side of the channels in which channels electrodes (30,31) are or are to be provided extending in the channels (20) and exiting the channels onto the peripheral part, characterised in that prior to or after providing the channels the peripheral parts are provided in the plate at a depth in between the bottom and the top of the channels provided or to be provided, and the channels are provided by means of moving a grinding wheel or grinding wheels over the plate along a direction, the grinding action being started at a position at some distance from an outer edge (57) of the plate (36) and being stopped before the grinding wheel reaches the opposite outer edge of the plate.

ABSTRACT:

A display device (10), such as PALC or PDP, comprises a plate (36) with channels (20) in which electrodes (30, 31) are provided. The peripheral part (50, 51) extend in plane (III) in between the bottom plane (I) though the bottoms of the channels and a to plane (II) through the top of the channels. The channels comprise a sloping part (55) gradually sloping from the bottom plane (I) to the peripheral part plane (III).

Figure 6.

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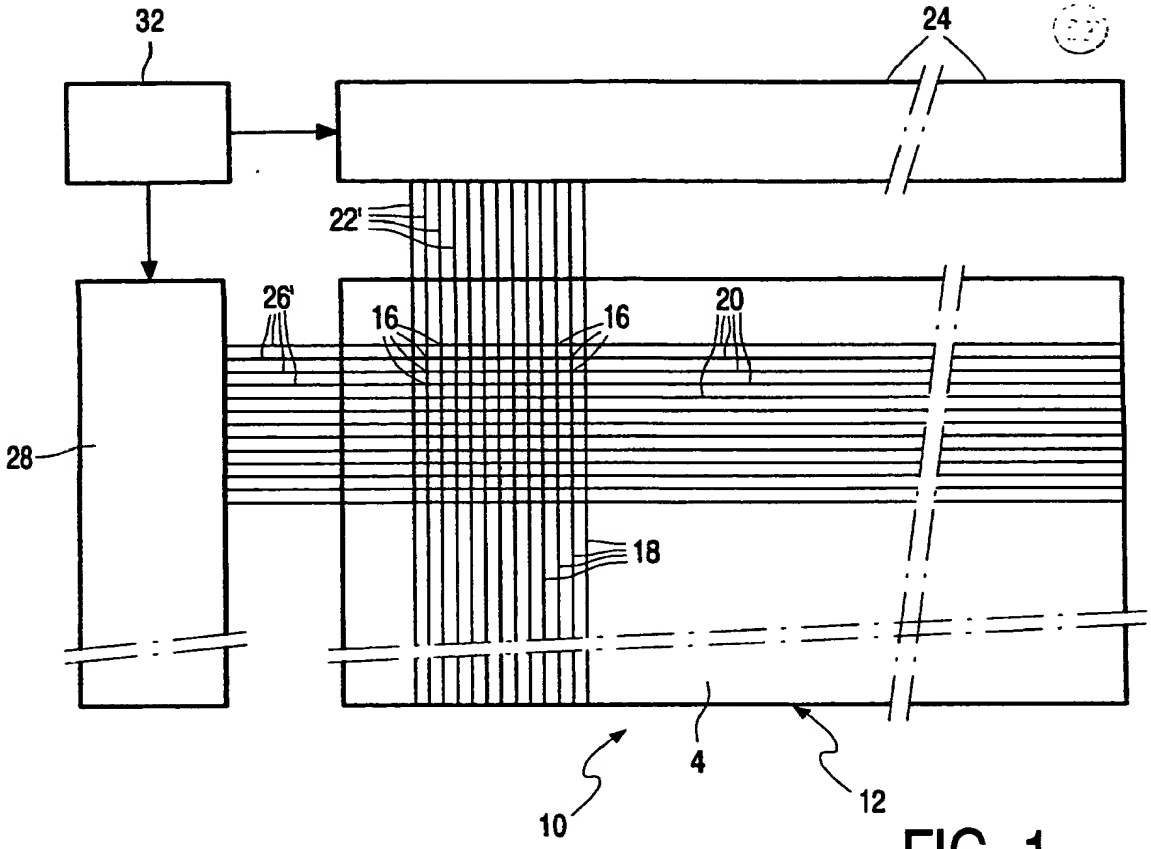
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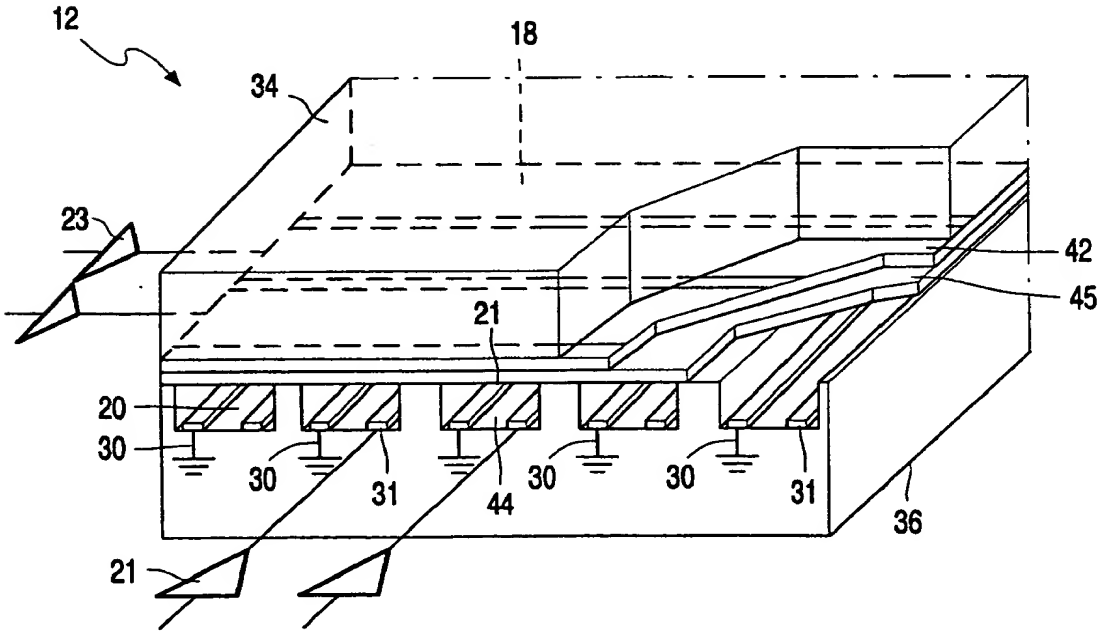
FIG. 1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21

FIG. 2

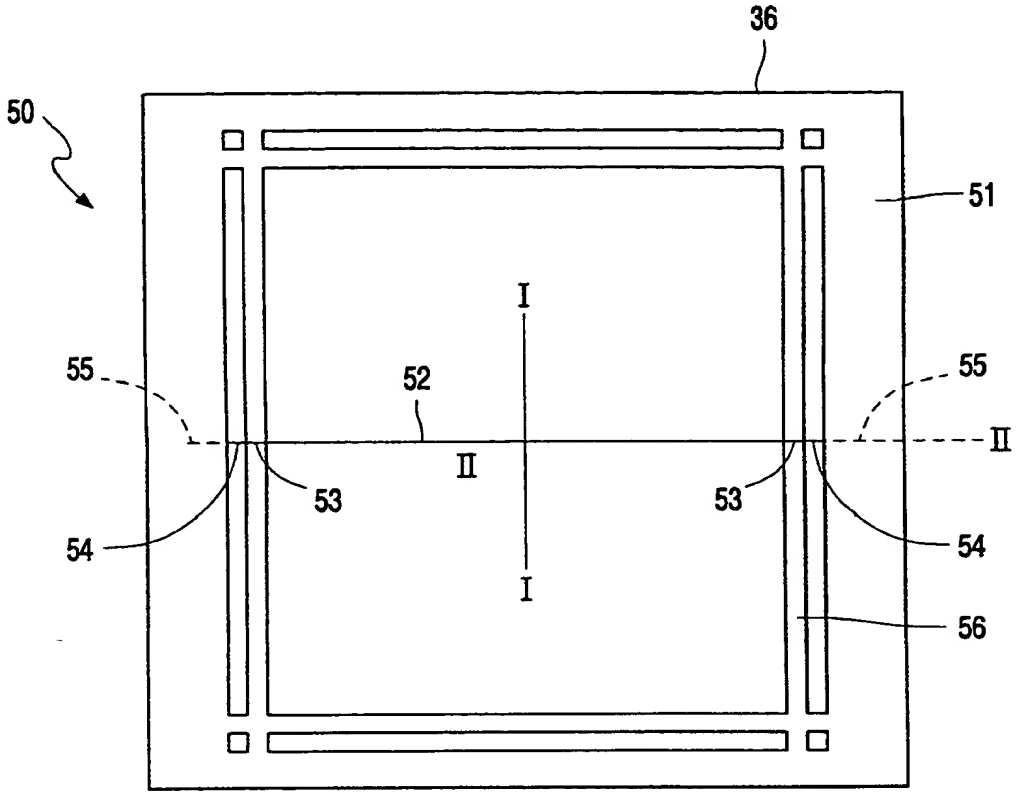

FIG. 3

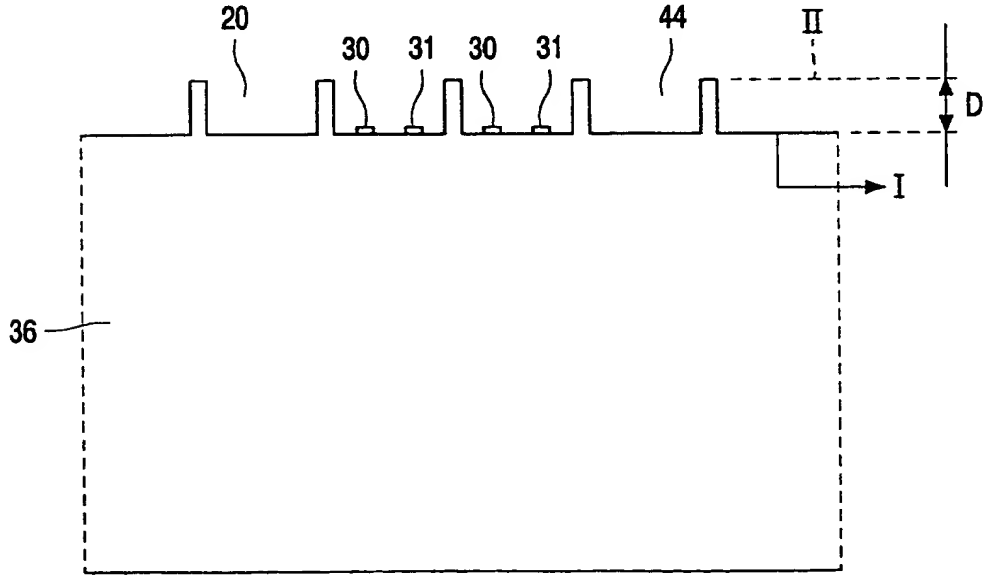

FIG. 4

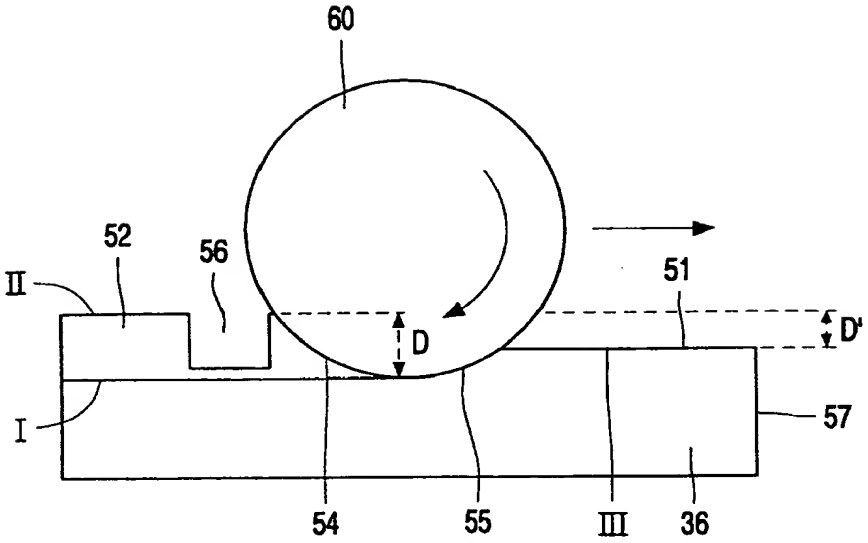

FIG. 6

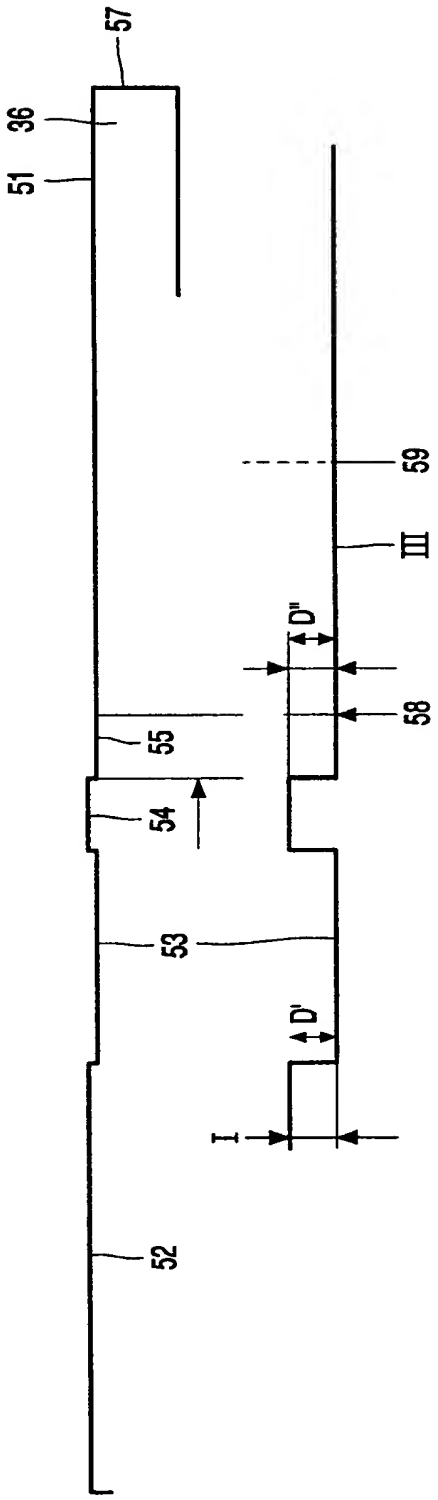

FIG. 5